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British Association for the Advancement of Science. Meeting at Glasgow, September 5th to 12th, 1928

A feature of the Glasgow meeting of the British Association was the number of papers in meteorology and allied subjects which were read in Section A. The meetings of that section began on Thursday morning, September 6th, with a discussion on "The Mechanism of Thunderstorms," opened by Dr. G. C. Simpson, Director of the Meteorological Office.

Dr. Simpson commenced with a reference to the breaking-drop theory which ascribes the origin of electricity in a thunderstorm to the breaking of the rain-drops held up within the cloud by ascending currents having a vertical velocity of more than 8 metres per second. The water after breaking has a positive charge, while the corresponding negative charge is given to the air. During steady rain there is a frequent collision of the rain-drops as they fall through the cloud, resulting in a separation of electricity, the rain becoming positively charged and the negative electricity going to the air in the cloud. The negative potential gradient in such conditions is explained by the rain falling to the ground and carrying its positive charge with it while the cloud remains with a negative volume charge. In a thunderstorm, however, there must be some other factor present to account for the large electrical forces produced. This, Dr. Simpson suggested, was the vertical component of the air currents. The main scheme of air currents in a thunderstorm was

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illustrated diagrammatically in a lantern slide. The air was shown as flowing towards the thundercloud near the ground and then rising vertically to fill the ever-expanding volume of the cloud. In the cloud, where the ascending currents are the greatest, the small drops are prevented from falling, causing an accumulation of water above the ascending current. Only the large drops can penetrate to the lower part of the region of maximum vertical velocity, where they are broken up into small drops, the water becoming positively charged and the cloud negatively charged. The cloud particles, however, moving with the full velocity of the air stream are rapidly separated from the water. There is, thus, an accumulation of positive electricity in the region of separation from which heavy rain carrying a positive charge falls, while the remainder of the cloud has a volume charge of negative electricity.

Turning to the form of lightning discharges, Dr. Simpson illustrated from photographs that the flashes start in the region of separation and are branched upwards towards the negative charge in the main cloud or downwards towards the ground. Occasionally discharges take place from the ground to the negatively charged cloud; such discharges are violent and are branched upwards. In tropical storms where the region of separation is higher, the main discharges take place within the cloud, conveying positive electricity downwards; others take place between the ground and the cloud, conveying positive electricity upwards. These results have been confirmed by observations by Watson Watt in Khartoum and by Schonland in South Africa. In conclusion, Dr. Simpson referred to the electrical field associated with a thunderstorm. The accumulated positive charge in the region of separation is dissipated constantly by lightning discharges, the cloud remaining negatively charged. The potential gradient is, thus, predominantly negative and the current from the ground is mainly positive. These results have also been confirmed by observations.

Professor C. T. R. Wilson, who followed Dr. Simpson, considered that the facts relating to the potential gradients associated with thunderclouds are interpreted most naturally on the view that the rain-drops in the cloud are negatively charged and the smaller particles positively charged, the clouds being thus of positive polarity. The fall of the negative drops relative to the small particles causes the accumulation of a positive charge above and a negative charge below. The fact that the upper atmosphere is highly ionised and that point discharges from the ground occur when the potential gradient is strong would generally result in unequal dissipation of the two originally equal charges. To explain the origin of the negative charge on the rain-drops Professor Wilson suggested a process which, like that of Elster and Geitel, would require the pre-existence of an

electric field. A drop suspended by a vertical current of ionised air in a field of positive potential gradient will acquire a negative charge if the upward velocity of the air stream relative to the drop exceeds the downward velocity of the positive ions relative to the air.

Dr. B. F. J. Schonland, continuing the discussion, referred briefly to his observations upon the electric fields of South African thunderstorms, which, he suggested, did not lend support to the type of cloud required by Dr. Simpson's theory. The two main objections to the latter were that one would expect upward discharges of positive electricity to occur owing to the strong field between the negatively charged cloud and the lower positive charge; and, secondly, that the uppermost negative charge fails to show itself when the "steady" field due to a thundercloud is observed. Dr. Schonland suggested that the positive charge observed on the rain from the centre of the storm is acquired by the drops in falling through a space charge of positive electricity liberated by point discharge from conductors and from vegetation on the ground.

Mr. R. A. Watson Watt suggested that the principal difficulty in discussing the mechanism of thunderstorms was the gross inadequacy of the experimental data available. He called attention to the importance of the direction of the current to earth immediately before a discharge as a criterion of the predominant moment. In a tropical storm the upper air discharges in which a positive charge moved downwards were of brief duration, low intrinsic brilliance, and were displaced in azimuth in the earth's magnetic field in a direction which indicated the sense of the current. In the discharges in which a negative charge passed from cloud to earth the intrinsic brilliance was relatively great, the duration of visible discharge was of the order of some seconds, and the azimuthal displacement was reversed. Recent photographs by Parkinson in Peru appeared to offer confirmation of these observations and to fit with Dr. Simpson's views as to the form of the discharge.

Professor J. J. Nolan, who concluded the discussion, said that the operation of the Lenard effect in the manner proposed by Dr. Simpson appeared to supply the only mechanism, so far put forward, which was competent to account for the separation of electricity occurring in a thunderstorm. It was possible, however, that other agencies played a subordinate part. Thus a rain-drop suspended in an intense electric field would begin to discharge from the end which carried the negative induced charge. Negative ions would be carried upwards by a vertical air current. In this way a pre-existing electric field due to a bipolar cloud with negative charge above would be rapidly increased, while a field of the opposite polarity would be decreased. This effect would work in the same direction as the

Simpson effect and would be, indeed, ancillary to it or to some other method of supplying the original field.

The Section A Presidential Address on Monday was followed by a paper by Mr. R. A. Watson Watt on "The Present State of our Knowledge of Atmospherics." The author described his paper as "a summary report of progress in a study of the morphology and etiology of atmospherics in themselves rather than a study in the pathology of radio communications." The paper, which reviewed in a series of illustrative diagrams the available evidence as to the origin and properties of naturally occurring electro-magnetic waves of radio-telegraphic frequency, covered considerable ground. The subjects discussed included the relative frequency of occurrence of atmospherics of different wave-forms, the mean directions of arrival of the predominant streams of atmospherics at various stations and their diurnal and seasonal variations, and the location of thunderstorms by radio-telegraphic direction-finding on atmospherics.

During the second half of the meeting Major A. H. R. Goldie communicated a paper on "Magnetic Storms," which was based on magnetic records from the Meteorological Office Observatories at Lerwick and Eskdalemuir, and in certain cases also from Abinger (Surrey). A comparison of records during magnetic storms showed that, in certain cases, the displacements in the vertical components of force at Lerwick were in the direction opposite to those recorded at more southerly observatories. This phenomenon was explained as due to a linear electric current system in the high atmosphere. It was estimated that the heights of the systems varied from about 100 to over 800 kilometres, and that the strengths of the currents rose to the order of half-a-million ampères. A feature common to most storms was that in the afternoon and early evening the current was directed from west south west to east north east, while after midnight its direction was almost exactly reversed. Reference was made to the relationship of the current positions to those of the auroral arcs and to the great cyclone track of the northern hemisphere. Finally, the possibilities were discussed of the induction of such currents by horizontal drift of a conducting atmosphere across the earth's magnetic field or by temporary increase of the conductivity of an atmosphere which was already subject to more or less regular diurnal movement.

On the last day of the meetings of Section A, Mr. M. A. Giblett, Superintendent of the Airship Services Division of the Meteorological Office, read a paper on "Wind Structure Research at the Royal Airship Works, Cardington," which gave an account of an investigation, now in progress, into the detailed gustiness and rapid changes of the wind as affecting the mooring of large rigid airships. The apparatus in use consists of four Dines Pressure Tube Anemometers for wind speed, with masts

50 feet high, the recorders being installed in four huts, three of which are at the corners of an equilateral triangle with sides 700 feet long (approximately the length of a large airship), while the fourth is at the middle point of one of the sides. The instruments are specially adapted so that the records on the charts show on a very open time-scale the individual gusts, even those which take only a few seconds to pass any one of the huts. Wind direction is registered on Baxendell direction recorders with similarly open time-scales. The huts are connected by an electrical timing system which enables any fluctuation in the wind at any hut to be timed to a second and so permits of accurate comparison between the records obtained in the different huts. A fifth anemometer with vane 150 feet above ground is also in operation and can be adapted as required for open scale work.

The basis of the analysis of the records is the tabulation of the wind speed and direction at each hut at intervals of only 5 seconds. Eddies of different magnitudes are then sorted out by an analytical process and their horizontal extent in different directions, rate of movement and degree of persistence studied. A second part of the research is devoted to a similar detailed examination of the rapid and almost instantaneous change from one general wind to another from a totally different direction, such as takes place when a line squall passes.

The fluctuations in the wind which the installation is specially suitable to study are those which take from 5 seconds to one minute to pass a given point. The results so far obtained are only provisional since, although much material has been collected for discussion, the examination of it has not yet proceeded very far. So far as this examination goes, however, it points to the fact that the fluctuations of period lying within the range mentioned are effects which travel down wind with the speed of the mean wind taken over an interval of 10 minutes, and that they have no appreciable speed relative to this mean wind, as might conceivably be the case. Further, even the longer period fluctuations, which may extend at any instant over a distance of the order of half a mile down wind, have a relatively narrow front across the wind. When the wind is blowing along the side of the triangle containing three anemometers, these may experience a similar régime, while that at the fourth anemometer, some 600 feet off this line, may be quite different.

A paper on " The Propagation of Air Waves to Great Distances in relation to the constitution of the upper atmosphere " was read by Dr. W. S. Tucker in the absence of the author, Dr. F. J. W. Whipple. After reference to experiments which took place after the war, when explosions of munitions were arranged in Holland, France and Germany, systematic observations of audibility being made by observers in different countries, a

description was given of a method of investigation developed recently in this country. Hot-wire microphones, similar to those used for sound-ranging during the war, had been installed at Birmingham, Bristol and Sheffield, and the waves produced by firing a 16in. gun on the Shoeburyness Range could be recorded regularly, even when the sound was not perceptible by ear. The average times taken by the air waves to reach Birmingham, Bristol and Sheffield were 12 min. 5 sec., 12 min. 52 sec. and 14 min. 33 sec., respectively. Observations giving the angle of descent of the air waves at the first two stations showed that the waves reaching Birmingham had the flatter trajectories. The analysis of the observations indicated that the heights reached by the waves are usually between 40km. and 50km., and that the velocity of sound at such heights is greater than near the ground. The observations thus confirm the theory of Lindemann and Dobson, according to which there is a region of warm air above the stratosphere.

The third paper, which was read by Mr. G. A. Clarke, was entitled "The Association of Cloud with Weather." It was illustrated by a series of beautiful lantern slides showing the more commonly experienced cloud forms. The types of weather associated with the different cloud formations were discussed and emphasis was laid on the importance of a detailed picture of the sky at different observing stations to those engaged in weather-forecasting from synoptic charts.

As in past years, the Meteorological Office, Air Ministry, with the collaboration of the Signals Branch, gave a demonstration of weather-forecasting based on broadcast synoptic data received locally by wireless. The demonstration was given in the Randolph Hall adjoining the Reception Room. A local *Daily Weather Report* was published and circulated to the various sectional meeting rooms, while the morning and afternoon synoptic charts were reproduced on a large-scale map in the Reception Room. In addition to the demonstration of forecasting an exhibit of instruments, diagrams and meteorological publications was arranged. The main feature of the exhibit was a display of instruments of the latest type in use at a distributive station of the Meteorological Office, the whole demonstration and exhibit thus illustrating the work of such a station. The diagrams included a series of photographs and "quick-run" anemograph records illustrating Mr. Giblett's paper on "Wind Structure Research," a large-scale map of average rainfall in the Glasgow area and a series of cloud photographs by Mr. G. A. Clarke.

The Meteorological Luncheon was held in the University and, as in past years, proved a very successful function. Those present included:—

Dr. G. C. Simpson, C.B., F.R.S. (in the chair); Sir Oliver

Lodge, O.M., F.R.S., and Miss Lodge; Lady Lockyer; Lady Bragg; Sir Richard Gregory; Professor H. H. Turner, F.R.S., and Mrs. and Miss Turner; Professor A. C. Seward and Mrs. Seward; Dr. H. Spencer Jones; Professor A. M. Tyndall, Recorder of Section A; Professor G. W. O. Howe and Mrs. Howe; Sir John Samuel, K.B.E., F.R.S.E.; Professor J. J. Nolan; Dr. Vaughan Cornish; Dr. W. S. Tucker; Dr. L. F. Richardson, F.R.S.; The Rev. E. D. O'Connor, S.J.; Dr. H. Borno; Dr. J. S. Owens and Mrs. Owens; Major A. H. R. Goldie; Mr. W. M. H. Greaves and Mr. F. Entwistle, Secretaries of Section A, and Mrs. Greaves; Mr. M. A. Giblett; Dr. H. Jefferies; Mr. R. S. Whipple; Mr. G. A. Whipple; The Rev. J. P. Rowland, S.J.; Dr. G. Merton and Mrs. Merton; Mr. F. A. Barton and Mrs. Barton; Mr. M. G. Bennett and Mrs. Bennett; Mr. T. W. Wormell; Mr. Trevor Dillon and Mr. H. B. Booth.

Dr. Simpson, in welcoming the guests, referred to the loss which meteorology had sustained during the past year in the deaths of Mr. W. H. Dines and Dr. Charles Chree. Sir Oliver Lodge proposed the toast of "Meteorology." After referring to the historical development of the science of meteorology in association with the names of its pioneers, he called attention to the weather chart of the day which had been reproduced on the back of the menu, and which showed a well-marked occlusion over the North Sea. The present day, he said, was one of discontinuities in scientific phenomena; there were discontinuities in electrons and discontinuities in meteorology. The Glasgow weather was a striking example of the result of the latter. Speaking of weather forecasts, Sir Oliver remarked on the accuracy of the Meteorological Office forecasts which were broadcast daily by the B.B.C. Finally, he congratulated the Chairman on his researches into the mechanism of thunderstorms, which had formed the subject of a discussion during the meeting. Major A. H. R. Goldie, replying to the toast, referred to the ever-widening sphere of application of the results of meteorological science. Sir Richard Gregory then proposed the toast of "The Allied Sciences (Terrestrial Magnetism, Seismology and Astronomy)," to which Professor H. H. Turner replied.

The excellent programme of local arrangements drawn up by the local Committee for the entertainment of the guests during the British Association Meeting calls for special mention. Unfortunately the unsettled weather during the early part of the meeting deterred several members from participating fully in the numerous excursions which had been arranged for the Saturday, and which included visits to many places of beauty and of historical interest for which the surroundings of Glasgow are justly famed. Numerous visits to Clyde shipbuilding and engineering works also figured in the programme, while other arrangements included a reception and dance in the City

Chambers, given by the Lord Provost and Corporation of Glasgow, and a reception and conversazione in the Kelvingrove Art Galleries, given by the Lord Provost and members of the Local Committee.

F. ENTWISTLE.

Official Publications Required

Copies of the following Geophysical Memoirs are out of print. As requests for these are sometimes received from important scientific libraries and institutions, the Director will be greatly obliged if any readers who possess copies which they no longer require will forward them to the Meteorological Office, Air Ministry, Kingsway, London, W.C.2.

GEOPHYSICAL MEMOIRS.

Vol. I. No. 1. The Effect of the Labrador Current upon the Surface Temperature of the North Atlantic, and of the latter upon Air Temperature and Pressure over the British Isles. By M. W. Campbell Hepworth, C.B., R.D.

2. Free Atmosphere in the Region of the British Isles. Second Report by W. H. Dines, F.R.S., with a Preface by W. N. Shaw, Sc.D., F.R.S.

3. Graphical Construction for the Epicentre of an Earthquake, by G. W. Walker, M.A.

5. International Kite and Balloon Ascents. By Ernest Gold, M.A.

6. Free Atmosphere in the Region of the British Isles. Third Report. The Calibration of the Balloon Meteorograph and the Reading of the Traces. By W. H. Dines, F.R.S.

Vol. II. No. 13. Characteristics of the Free Atmosphere. By W. H. Dines, F.R.S.

16. Aids to Forecasting. Types of Pressure Distribution, with Notes and Tables for the Fourteen Years 1905-18. By E. Gold, F.R.S.

Discussions at the Meteorological Office

October 29th. *The evaporation of sea water and the thermal intercourse between the sea and atmosphere.* By Was Shoulejkin (Beitr. Geophysik, Leipzig, 20, 1928, pp. 99-122). *Opener*—Mr. R. S. Read, M.A., B.Sc., F.Inst.P.

During a voyage from the Black Sea to Vladivostok viâ the Mediterranean, Red Sea, Indian Ocean, China Seas and Japan Sea, measurements were made of the rate of evaporation of suc-

cessive samples of sea water when placed in a special type of evaporimeter. Simultaneous observations were made of air and water temperatures, vapour pressure, and wind velocity. From the rate of cooling of the known quantity of sea water in the evaporimeter, values were obtained for the rate of loss of heat. From the whole of the results obtained on the voyage, it was found that the ratio of the rate of evaporation to the water vapour deficit in the air was directly proportional to the wind speed. Curves were next constructed to connect the rate of loss of heat with the difference of the air and water temperatures. It was found that (i) for water temperature greater than air temperature, the rate of loss of heat from the water to the air was directly proportional to the temperature difference; and (ii) for water temperature less than air temperature, no definite law could be established from the available observations.

In order to extrapolate from the results obtained on board ship to determine the rate of evaporation at the sea surface, a further series of observations was performed over the Black Sea, and during the voyage, to determine the rate of change of wind velocity, temperature and vapour pressure with height above the sea surface. These extrapolated results were then compared with direct measurements at the surface of the sea, when differences not exceeding 6 per cent. were obtained for the ratio of the rate of evaporation to the vapour pressure deficit.

The author hopes by these measurements to be able to calculate the amount of water evaporating in different zones of the seas by making use of observations of prevailing winds, air and water temperatures and vapour pressure.

The subjects for discussion for the next meetings will be:—

November 26th.—*Twelve years of long-range forecasts of precipitation and water level.* By A. Wallén (Ann. Hydrogr. 54, 1926, Köppen-Heft, pp. 89-99) (in German), and other papers. *Opener*—Sir Gilbert Walker, C.S.I., F.R.S.

December 10th.—*Measurement of variable velocity relative to air with pitot-static tube.* By K. Wada and S. Nisikawa. (Tokyo, Rep. Aeron. Research Inst. 2, 1927, No. 13, pp. 327-393.) *Opener*—Mr. A. C. Best, B.Sc. Mr. L. F. G. Simmons will speak on "Recent research work on the Dines anemometer at the National Physical Laboratory."

Correspondence

To the Editor, *The Meteorological Magazine*

Meteor seen from Horndon-on-the-Hill

While proceeding home at about 20h. 35m. B.S.T., on Sunday, September 30th, my mother, brother and I observed a brilliant

pyriform green meteor appear in the north about 15° above the horizon, and speed with a very slight inclination to the earth due east, turning a dull red, and vanishing with a suggestion of smokiness before reaching the horizon. The sky was clear with only an isolated piece of cumulus in the south, and exceptionally bright moonlight.

F. CLAUDE BANKS.

Market Gardens, Horndon-on-the-Hill, Essex. October 1st, 1928.

Ball Lightning

To-day at 1.20 p.m. I was looking out of a window facing due east, when I saw, about 8 feet above the ground, a ball of fire about 3 feet in diameter, which exploded with a terrific crash into forked flames. There was no warning, no vibration, no sign of anything on the ground afterwards, and the atmosphere was dull but quite normal. About ¼ hour after we heard a distant rumble like thunder, and at the moment of the explosion we all felt a shock.

F. E. CRAWFORD.

Dowlands, Smallfield, Horley, Surrey. October 25th, 1928.

[It is possible that this may have been a case of ball lightning. The *Daily Weather Reports* show that southwesterly winds and showery weather prevailed over the British Isles on the 25th. During the afternoon and evening heavy showers of rain fell at several places in southern England, a thunderstorm was reported at Kew Observatory and thunder was heard also at Ross-on-Wye and Southampton.—Ed. *M.M.*]

A Pink Rainbow; Solar and Lunar Halo

On October 8th an unusually red sunrise developed at 6 a.m., the entire eastern sky becoming a sheet of pink and crimson by 6.5 a.m. At 6.6 a rainbow formed to the westward, pink in colour, this being the sole colour visible, it was bright throughout its entire circumference, but extremely bright in the southern segment, where a portion of a secondary bow was visible, showing the same single colour, pink. The rainbow disappeared at 6.11. The sky was almost wholly covered with cirro-stratus and alto-stratus, isolated large raindrops falling from the alto-stratus. The redness in the eastern sky was maintained to 6.15, two minutes after the actual time of sunrise.

The unusual combination of a solar and lunar halo visible at the same time was seen on the morning of April 7th last at 5.30 a.m. The sun rose at 5.24 a.m. and moonset was at 6.45 a.m. Both halos showed prismatic coloration.

SPENCER RUSSELL.

Hurlingham, S.W.6. October 10th, 1928.

Mock-suns

While at South Stoneham, near Southampton, yesterday, I observed both parhelia of the halo of 22° in conjunction with that halo. A degree or two above the left parhelion was a patch of light nearly as big as the parhelion, which was probably due to reflection from a particularly dense patch of cirrus of cirro-stratus. The time was 15h. 25m.

S. E. ASHMORE.

Windwhistle Cottage, Grayshott, Hindhead, Surrey. October 21st, 1928.

Mock-suns are interesting and beautiful phenomena, but as usually seen, the observer is not likely to be deceived in the manner implied by their name. In my experience, the sun itself is usually seen shining fairly brightly through the cirrus or cirro-stratus cloud responsible for the mock-sun, and the latter is seen as a comparatively feeble luminous patch. On Sunday afternoon, October 21st last, I was fortunate enough, however, to see a mock-sun that really lived up to its name. At about 16h. wisps of so-called "false cirrus" above a cumulus head appeared very brightly illuminated. There was a strong reddish coloration on the western edge and a suggestion of bluish purple on the eastern edge, but otherwise the appearance was exactly what one would expect to see had the sun been behind the cumulus head. Both my wife and myself were intrigued by the colouring and thought we were looking at an unusual type of "iridescence," and we were both surprised when the sun itself suddenly appeared from behind another cumulus head about the right angular distance further west. We concluded, therefore, that we were looking at a mock-sun of quite unusual brilliance. The phenomenon was seen near Wimbledon.

E. G. BILHAM.

Richmond. October 25th, 1928.

To-day (Oct. 22nd) at 4.5 p.m. (G.M.T.) a rather unusual parhelion, or "mock-sun," was observed by me. The weather was squally and showery, and during a break in the heavy shower cumuli the mock-sun shone sufficiently brilliantly to throw a distinct shadow into my study window, as the real sun would do when shining through cirro-stratus. The real sun to-day being hidden at 4.5 p.m. behind heavy clouds, the mock-sun shone with a brilliance that seemed almost "uncanny." By 4.8 p.m. both real and mock-sun became visible, and on measuring the angular distance between the two objects I found it to be exactly 45°, the mock-sun being that distance to the north.

Although this parhelion was at first a brilliant white, it afterwards assumed prismatic colours. This phenomenon is known to seamen as a "wind-dog," and certainly on this occasion it

was a " true prophet," for high winds and rain followed within a very few hours!

The barometer at the time was 29.71in. falling slowly; temperature 51°F, and wind SW, gusty.

DONALD W. HORNER.

63, *Canute Road, Clive Vale, Hastings. October 22nd*, 1928.

Vertical Visibility and Convection

An examination has been made of the records furnished during 1926 by the Meteorological Flight of the Royal Air Force, stationed at Duxford, Cambridgeshire, in order to determine whether any relationship was apparent between the degree of vertical visibility, estimated looking downwards, and convection currents in the air.

The observations of visibility considered were those taken, when possible, from a height of 6,500 feet, approximately, and the presence or absence of clouds of cumulus or cumulo-nimbus type at the time of observation was taken to denote the presence or absence of convection currents. The time of the flights was in every case about 14h. or 15h. G.M.T., and the flights considered, 65 in number, were spread, more or less evenly, over the whole year.

The results are shown in the following table :—

	No. of flights.	Percentage No. of flights when vertical visibility was			
		Very Good.	Good.	Indifferent.	Poor.
Convection present...	22	82	9	4·5	4·5
Convection absent ...	43	47	16	28	9

The table suggests that with convection present the vertical visibility is distinctly better than with convection absent, a result paralleled by that obtained by one of the present writers with regard to horizontal visibility at Cranwell, Lincolnshire.*

W. H. PICK.
J. PATON.

August 18th, 1928.

Waterspout seen near Cattewater

Flight Lieutenant Rankin reports that while flying on October 6th, 1928, about eight miles southwest of this station he observed a waterspout at about three miles distant on his port side. He first saw the spout descending from an enormous cumulo-nimbus cloud at 9h. G.M.T. Meanwhile the sea to the

*See *Meteorological Magazine*, 62 (1927), p. 289.

right of it became much disturbed, a column rose up quickly towards the spout and the two portions became connected by a misty veil. This state lasted for about a minute, but the sea was disturbed for some considerable time comparatively—roughly five minutes—afterwards.

The wind at the time was between southwest and west, 20 m.p.h. up to 3,000ft., the height of the cloud was 1,500ft. in the vicinity of the waterspout and the weather fair or fine.

Flying Officer Cracroft, who was a passenger in the machine and who also observed the waterspout, adds (i) that rain was not falling from the cumulo-nimbus cloud and no rain was observed to fall afterwards, and (ii) that as they were proceeding towards the waterspout they were unable to see whether it was displaced towards or away from them.

T. H. APPLEGATE.

R.A.F. Station, Cattewater, Plymouth. October 12th, 1928.

NOTES AND QUERIES

Waterspouts off the Isle of Wight

On June 11th, about 10.30 a.m., no fewer than five waterspouts were seen between the eastern point of the Isle of Wight and the coast of Hayling Island. They formed near the Nab and drifted south-south-west until opposite Bembridge Ledge, where they dissipated. A detailed description of one of them has been furnished by an eye-witness, Captain R. C. Lloyd Owen, R.N., who writes as follows:—

"The cloud was a very heavy dark cloud and a spout fell from it from a height of about 1,000 to 1,500 ft.; on the surface of the water the spout sent up what looked like steam splashes about 200 ft. high. It fell at about 10 a.m. and continued to fall on the sea for about 3 to 4 minutes. It fell as far as I could estimate about 2 minutes of arc south-east of the Nab Lighthouse Beacon and at the time there was only one vessel in sight. This vessel was a steamer and about one to two miles away from the waterspout. I have seen several waterspouts in eastern waters but never one so pronounced and so near at hand. My wife also saw this with me as did several other persons on Hayling Island sea front."

Mr. H. Herrod, of 26, Worthing Road, Southsea, stated in the *Portsmouth Evening News and Southern Daily Mail* for June 11th, that "At 10 o'clock . . . a fairly heavy dark cloud overlay the water at a considerable height. From the cloud to the surface of the sea there extended a vertical column of water, extremely dark, almost black in colour. At the distance it was difficult to gauge accurately the diameter of the column, but I should say it was from 60 to 80 feet. Where it met the water, an extremely large amount of spray was visible

after a time. As the cloud moved over, the head of the column followed it, giving a somewhat sinuous effect. After several minutes the column dissolved at the junction with the cloud and disappeared slowly along its length, and the spray subsided; and then nothing was visible. At 10.40 a much lighter waterspout appeared, extremely sinuous in fall, extending from the cloud at an angle of 45° and joining on the near side of the Nab lighthouse, but slightly to the west of it, travelling past the Nab fairly rapidly. This was of about two or three minutes' duration."

On the morning of the 11th, southern England was covered by a westerly air current of "Polar" origin behind a rather intense depression which crossed from western Ireland over southern Scotland during the 9th and 10th.

During the 11th showers, accompanied in some cases by hail and thunder, occurred at several stations in the southern half of England, 6 mm. of rain being recorded at Falmouth, 2 mm. at Cattewater and 1 mm. at Calshot.

While surface temperatures were about normal, or only slightly below, upper air temperatures, as shown by an aeroplane ascent at Duxford at 9h., were considerably below the June normal and, at heights of from 6,000 to 11,000 ft., some 5 degrees below the usual temperature of "Polar" air in June. There was considerable instability in the lower layers over Duxford, and, much the same conditions probably prevailing in the south, there was every opportunity for the vigorous convection necessary for the formation of the waterspouts.

The London "Tornado"

During the evening of October 22nd a small secondary depression moved across southern England, giving rise to heavy rain and, locally, to destructive squalls of wind in its passage. The *Daily Weather Reports* show that the secondary had appeared southward of Ireland by 7h. G.M.T. on the 22nd, and then moved first almost eastward to the Scillies, and later more nearly northeastward at an average speed of about 25 miles an hour across the London district to the southern North Sea. At 18h. G.M.T. the centre was situated near the Dorset coast and the area of strong winds appeared to be about 150 miles in diameter, while force 7 on the Beaufort scale was recorded at Southampton and Guernsey, force 6 at Portland Bill and force 5 at Plymouth; by 1h. G.M.T. on the 23rd the centre had moved across London to Essex, the winds at Portland Bill and Southampton had dropped to force 5 and at Guernsey to force 4, having veered from S. or S.W. towards N.W. Upper air temperature observations made at Duxford (Cambs.) on the afternoon of the 22nd

showed an unusually high lapse rate of temperature, averaging about 4.0° per 1,000 feet up to 17,760 feet, and exceeding in parts of the ascent the " dry adiabatic " rate. Conditions were favourable for the development of strong convectional movements.

According to newspaper reports a strong wind struck Hythe (Hants) about 6 p.m., trees being blown down, and some damage caused to buildings, while Mr. H. F. Jackson, Meteorological Officer at the Calshot seaplane station, had a narrow escape from injury when a falling tree struck his motor-car.

Between 6 p.m. and 9 p.m. rain fell heavily in the London area, about an inch being the general fall, while locally in the west-end the wind attained destructive force, a sudden squall, said to have lasted no longer than thirty seconds, causing structural damage estimated at upwards of £15,000. Fortunately no loss of life was caused in spite of the quantities of masonry blown into the streets, the heavy rain having driven people to shelter. Owing to the unusual occurrence, considerable Press comment was excited, the wind phenomenon being variously described as a gale, cyclone, tornado, whirlwind, or wind vortex.

An appeal to the public for information, which was issued by the Director of the Meteorological Office, met with a gratifying response, 266 communications being received, 219 of which were accompanied by barograms.

A preliminary notice issued to the Press states that " From the records received it appears that the disturbance moved northwards along a straight track of small width from near Victoria Station to Euston, passing near Piccadilly Circus and Oxford Circus. It then continued in the same line with diminished intensity. Barograms on the track differ from those off it in showing an additional very sudden fall and recovery of the barometer as the disturbance passed. They tend to confirm that the phenomenon had many of the characteristics of an American tornado." It was also stated that a similar kind of disturbance occurred at Bromley, Kent.

The occurrence of tornadoes is not unprecedented in this country. The South Wales tornado of October 27th, 1913, of which an investigation was published as *Geophysical Memoirs, No.* 11, was shown to have been a genuine tornado of the American type

Under the heading " whirlwinds " the index volume to *Symon's Meteorological Magazine,* 1866-1895, gives about 40 references to occurrences in the British Isles. These vary considerably in intensity, a " whirlwind " at Hampstead on August 14th, 1887, raised a column of dust about 9 feet in diameter to a height of 30 feet. Another " whirlwind " which passed over Cowes on September 28th, 1876, caused much damage in the town and neighbourhood, the loss to property being estimated at

upwards of £10,000. This storm struck the town soon after 7h. , lasting about two minutes, then seems to have crossed the Solent and passed up country between Portsmouth and Titchfield, causing further damage in its progress inland. It is of interest to note that the *Daily Weather Report* for this day shows that at 8h. a small depression was centred over the Bristol Channel, the circular isobar for 29.4 in. enclosing an area about 200 miles in diameter. The depression appears to have moved eastward across England, the centre passing northward of the Isle of Wight, and rainfall was less in amount, places near the track recording about half an inch. At Oxford, however, 0.87 inch was measured.

The tornado of October 22nd, 1928, is being made the subject of a special inquiry, and any relevant information will be welcomed by the Director of the Meteorological Office.

West Indian Hurricane

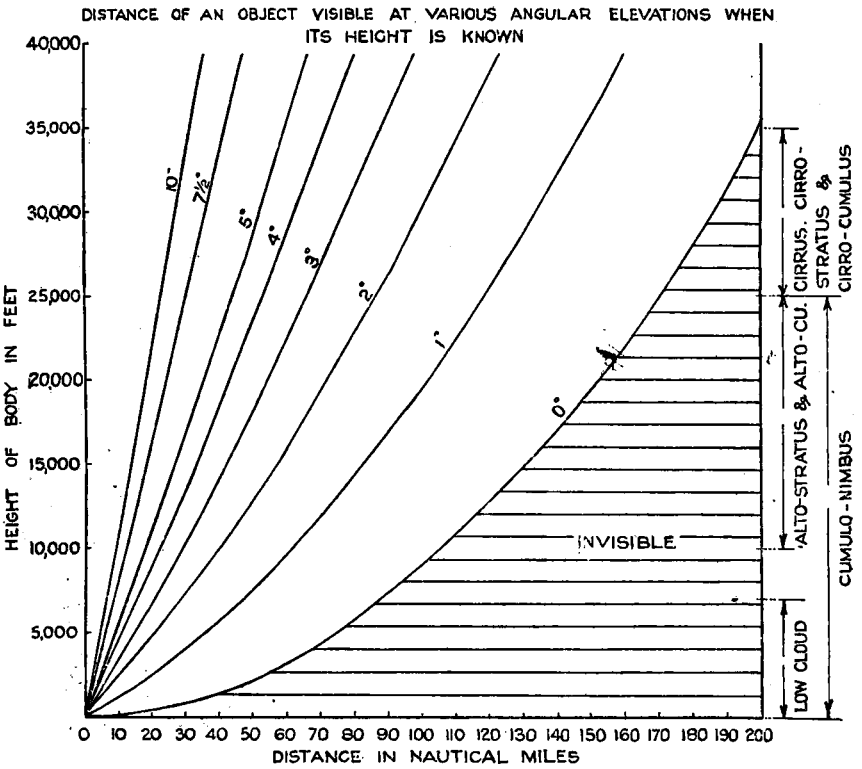
Two interesting accounts of the exceptionally violent West Indian hurricane of last September have been received from the observers for the Réseau Mondial stations at Montserrat (Leeward Islands) and Nassau (Bahamas). At the former place the observer, Mr. C. H. Gomez, maintained hourly readings of the barometer up to 6 p.m. on September 12th, when a reading of 28.38 inches was made. His enthusiasm as a meteorological observer is evidently very great, for one hour earlier the porch of the house had blown away in the northerly wind, which was estimated to have reached 120 m.p.h. at that time. Soon after 6 p.m. the roof began to move and the observer took himself and the barometer to a place of greater safety. The next hourly reading showed a rise of pressure: the minimum was estimated to have been 28.1 inches. The wind veered to southeast very quickly without falling below a severe hurricane, and the centre was believed to have passed very close to the northwest of Montserrat. The raingauge had overflowed next morning, after recording 9 inches. Nassau did not experience the full fury of the storm until the early hours of the 16th, when a northeasterly hurricane set in. The minimum of pressure, 28.08 inches, occurred at 5 a.m., with a southwesterly wind estimated at 110-120 m.p.h. The anemometer cups had blown away an hour and a half earlier in a wind of 96 m.p.h. At this station nine inches of rain were recorded during the storm.

Mr. Talman, of the Washington Weather Bureau, states in one of his *Science Service* articles, that at Porto Rico this storm was apparently more severe even than that of August 8th, 1899, when over 3,000 lives were lost, and in the course of which one place recorded 23 inches of rain in 24 hours.

E. V. NEWNHAM.

The Visible Distances of Clouds

One evening when the sky was covered with a uniform layer of alto-stratus cloud emanating from a depression over France, the colouring of the sunset at Bedford was most magnificent when for a few minutes the sun burst through between the edge of the layer and the horizon. Rain had been falling during the afternoon and beneath the cloud layer there was a great amount of moisture in the atmosphere giving a blood red colouration to the sunset. From the weather chart it appeared that the cloud layer extended all over the Midlands, and the writer was some-



what surprised that the sun's rays should have been able to pierce between the cloud and the horizon. A simple calculation, however, showed that if the layer was at a height of 20,000 feet the edge could still be seen at a distance of 150 miles (*i.e.*, near the Welsh Coast).

That clouds could be seen so far away was new to the writer, and the calculation was extended to other heights resulting in the figure attached, which gives for various heights the distances at which objects in the air subtend various angles. One or two facts drawn from this figure are perhaps worth noting.

(i) Cirrus plumes rising on the horizon may be as much as

200 miles away, but a cloud that has ascended to 5° above the horizon cannot be more than 60 miles from the observer.

(ii) A towering cumulo-nimbus cloud observed in London may lie over the Bristol Channel.

(iii) The base of a line squall cloud (at, say, 2,000 feet) may be seen on the horizon 50 miles from the observer.

To an aeroplane at a height of 10,000 feet these distances are extended by more than 100 miles, and the maximum visible distance of cirrus cloud becomes 300 miles, *i.e.*, an aeroplane flying 10,000 feet above London could see cirrus cloud that lay above Dublin.

A very similar diagram is published in the *Meteorological Glossary* under the heading " Horizontal." The diagram given there, however, extends only to 10,000 feet and is only applicable to clouds on the horizon, whereas to an observer who is confronted with the question of the distance of a visible cloud it is of great importance that the diagram should include the distances at which different angular elevations are subtended.

C. S. DURST.

Pilot Balloon Reports from Ships at Sea

Measurements of upper winds by means of pilot balloons have been made occasionally on board ship for many years past, but the results have not usually been available to meteorologists until publication of the readings a considerable time after the date to which they refer. It would clearly increase the value of the results if they could be transmitted by wireless for the use of forecast services in the same way that ordinary surface observations at sea are now sent.

A proposal for the development of this work was brought before the meeting of the International Commission for Synoptic Weather Information, held in London last May, by Vice-Admiral Dominik of the Deutsche Seewarte. Acting on this proposal the Commission recommended that a joint sub-commission should be appointed for the investigation of the upper air over the ocean in order that the matter might receive detailed consideration.

Vice-Admiral Dominik was able to report that some preliminary steps had already been taken in Germany, the ships which had participated in recent research voyages to study the higher strata of the air over the Atlantic having communicated their wind measurements whenever possible by wireless to Norddeich. It is interesting to record that during September some reports, taken on the *Monte Olivia* of the Hamburg-South American Line as she proceeded down the English Channel, were broadcast from Lindenberg. Similar reports were also made by a German Fishery cruiser in the North Sea, one of these reaching the unusual height of 36,000 feet.

J. S. DINES.

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Deutsches Meteorologisches Jahrbuch, 1926, Freie Hansestadt Bremen. Edited by Dr. A. Mey, Bremen, 1928.

Raporto de la Aerologia Observatorio de Tateno. No. 2. Tateno, Japan, 1928.

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News in Brief

Weather Lore. By R. Inwards. Any reader, prepared to dispose of a copy of the 1898 or 1900 edition of this book, is requested to communicate with " Weather Lore " through the Royal Meteorological Society, 49, Cromwell Road, South Kensington, S.W.7.

The Weather of October, 1928

Westerly winds and mild, unsettled weather prevailed generally throughout October. During the first few days, however, an anticyclone passed across the country giving generally fair weather with brilliant sunshine on the 1st and 4th, *e.g.*, 10.5hrs. at Oxford on the 1st, 9.9hrs. at Ventnor and Littlehampton on the 4th, and much frost at night. On the 1st, 25°F was registered in the screen at Marlborough and Rhayader, and on the grass 14°F, the lowest grass minimum temperature of the month, at Rhayader, and 19°F at Ford (Argyll) and Dumfries. On the 4th a deep depression over the Atlantic was spreading east, so that for the next week westerly winds and unsettled weather with bright intervals prevailed. Rainfall was heaviest in the west and north, and slight in the southeast. Among the heaviest

falls were 3.30in. at Fofanny (Down) on the 10th, 2.50in. at Rosthwaite (Cumberland) on the 7th, and 1.73in. at Eskdalemuir on the 7th. Temperature rose considerably during this period, 65°F and above being recorded in many places, with 68°F at Collumpton, Greenwich and Hull on the 8th. On the 11th and 12th a depression crossed the southern districts of the British Isles giving moderate rain generally in the south, while in the north the conditions were mainly fine. Inverness had as much as 9.3 hrs. bright sunshine on the 12th. Thunderstorms occurred locally in the south from the 9th to 12th. A short period of fair cold sunny weather ensued on the 13th and 14th during the passage across the country of a belt of high pressure, but by the 15th the winds were again becoming westerly and the weather unsettled. These westerly winds continued to prevail until the 26th, often becoming strong in places with gales at times. On the night of the 19th to 20th a gust of 84 m.p.h. was recorded at Valentia and one of 81 m.p.h. at Holyhead, while Beaufort force 9 (50 m.p.h.) was reported from one or two stations on the 18th, 19th, 20th, 24th and 26th. On the 22nd a destructive wind storm of short duration passed across London.* Rain fell on most days over the country generally, although there were many bright intervals; the heaviest falls occurred on the 26th, 2.19in. at Guernsey, 2.14in. at Selbourne, and 2.02in. at Aasleagh (Mayo). After this, on the 28th came the third and shortest period of anticyclonic weather with bright sunshine; both Torquay and Weymouth had 8.7hrs. on this day. This ended on the 29th, when the country again came under the influence of a depression approaching from the Atlantic, and showers and bright intervals prevailed until the end of the month with strong northerly winds during the latter part of the 31st. During the month rainfall totals were generally above normal, but sunshine totals were variable. The total of 111hrs. at Kew was 19hrs. above normal, that of 100hrs. at Liverpool 14hrs. above normal, that of 124hrs. at Falmouth 8hrs. above normal. Stornoway and Dublin had also 7hrs. and 5hrs. excess sunshine respectively, but Aberdeen, Valentia and Birr Castle had all less than normal, the deficit at Birr Castle being as much as 16hrs.

Pressure was below normal over northern and western Europe, Iceland and the North Atlantic to Newfoundland, the greatest deficit being 7.8mb. in the Atlantic at about 50°N, 30°W. Pressure was above normal over Spitsbergen, southern and central Europe, the Azores and Bermuda, the greatest excess being 5.3mb. at Horta. Temperature was below normal at Spitsbergen, northern Scandinavia, and central Europe, and above normal in southern Scandinavia, British Isles and Portugal.

* See p. 238.

Rainfall was generally in excess in Scandinavia (about 80 per cent. above normal in eastern Svealand) and the British Isles and deficient in central Europe and at Spitsbergen.

The floods near Nieuport (Belgium) caused by the gale on the night of September 30th to October 1st resulted in no serious damage and the water receded after two days. Abundant rain in the Canton of Ticino (Switzerland) about the 5th accelerated the landslips at Motto Arbino and also raised the level of the Ticino river thus helping to cause more damage in the Arbedo Valley. Snow fell near Dijon on the 15th and a sudden drop in temperature accompanied by snowfall occurred in the Black Forest, the lower Alps and on the Saxon frontier between the 13th and 15th. Heavy rain in Switzerland, southern France and northern Italy about the 23rd caused serious floods in many parts, the railway between Geneva and Lyons being cut in five places. For a few days the weather improved, but from the 25th to the end of the month there was torrential rain in some part or other of these regions with renewed flooding. Floods were also experienced along the Tiber and in Rome owing to the heavy rain about the 29th to 31st.

Heavy rain was experienced in the Deccan between the 1st and 3rd and in Madras about the 22nd. Rainstorms were also recorded in Honshiu (Japan) about the 17th.

A northwesterly gale did much damage in New South Wales on the 7th, and bush fires were experienced in many parts of that State about the same time. Owing to the late rains which prevented spraying the peach orchards in Victoria (Australia) have been ravaged by a plague of green aphis.

The total rainfall for the month in Australia was generally above normal except in Victoria and Tasmania.

Storms on the North Atlantic between the 12th and 15th, and again between the 29th and 31st, caused the airship *Graf Zeppelin* to take a southerly course both when crossing to America and on the return voyage.

The special message from Brazil states that the rainfall in the northern and southern regions was plentiful with 0.43in. and 1.65in. above normal respectively, while in the central regions it was scanty with 2.64 in. below normal. Six anticyclones passed across the country and strong winds prevailed in the extreme south during the first part of the month. The crops generally were in good condition except in the northeastern districts, where they had suffered from lack of rain. At Rio de Janeiro pressure was 0.7mb. above normal and temperature 0.2°F. below normal.

Rainfall, October, 1928—General Distribution

England and Wales ...	147	per cent. of the average 1881-1915.
Scotland	145	
Ireland	165	
British Isles	150	

Rainfall: October, 1928: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent of Av.
Lond.	Camden Square	3·41	130	*Leics.*	Thornton Reservoir ...	4·23	151
Sur.	Reigate, The Knowle...	5·81	185	,,	Belvoir Castle.....	3·60	133
Kent.	Tenterden, Ashenden...	6·48	186	*Rut.*	Ridlington	3·56	...
,,	Folkestone, Boro. San.	5·94	...	*Linc.*	Boston, Skirbeck	3·95	144
,,	Margate, Cliftonville...	3·28	112	,,	Lincoln, Sessions House	3·51	138
,,	Sevenoaks, Speldhurst	5·68	...	,,	Skegness, Marine Gdns	3·33	122
Sus.	Patching Farm	7·99	222	,,	Louth, Westgate	4·31	133
,,	Brighton, Old Steyne	7·46	193	,,	Brigg, Wrawby St. ...	4·20	...
,,	Tottingworth Park ...	9·15	220	*Notts.*	Worksop, Hodsock ...	4.79	132
Hants.	Ventnor, Roy. Nat. Hos.	8·96	228	*Derby.*	Derby	3·92	150
,,	Fordingbridge, Oaklnds	7·11	172	,,	Buxton, Devon Hos....	6·42	131
,,	Ovington Rectory	8·43	208	*Ches.*	Runcorn, Weston Pt.	3·45	100
,,	Sherborne St. John ...	5·26	150	,,	Nantwich, Dorfold Hall	3·97	...
Berks.	Wellington College ...	3·31	101	*Lancs.*	Manchester, Whit. Pk.	3·94	119
,,	Newbury, Greenham...	5·30	151	,,	Stonyhurst College ...	6·12	136
Herts.	Benington House	...	...	,,	Southport, Hesketh Pk	5·57	157
Bucks.	High Wycombe	4·70	150	,,	Lancaster, Strathspey	5·75	...
Oxf.	Oxford, Mag. College	3·21	115	*Yorks.*	Wath-upon-Dearne ...	4·79	173
Nor.	Pitsford, Sedgebrook...	4·11	153	,,	Bradford, Lister Pk....	5·04	145
,,	Oundle	2·81	...	,,	Oughtershaw Hall.....	10·57	...
Beds.	Woburn, Crawley Mill	3·63	136	,,	Wetherby, Ribston H.	4·69	156
Cam.	Cambridge, Bot. Gdns.	2·49	105	,,	Hull, Pearson Park ...	4·58	154
Essex.	Chelmsford, County Lab	3·34	136	,,	Holme-on-Spalding ...	3·09	...
,,	Lexden, Hill House ...	2·03	...	,,	West Witton, Ivy Ho.	6·13	...
Suff.	Hawkedon Rectory ...	3·23	120	,,	Felixkirk, Mt. St. John	3·63	126
,,	Haughley House	1·92	...	,,	Pickering, Hungate ...	3·90	...
Norf.	Beccles, Geldeston.....	...	...	,,	Scarborough	3·16	101
,,	Norwich, Eaton..... ...	2·74	88	,,	Middlesbrough	2·56	85
,,	Blakeney.....	2·88	110	,,	Baldersdale, Hury Res.	3·65	...
,,	Little Dunham	3·45	111	*Durh.*	Ushaw College	3·20	93
Wilts.	Devizes, Highclere.....	4·44	143	*Nor.*	Newcastle, Town Moor	2·85	89
,,	Bishops Cannings	4·77	144	,,	Bellingham, Highgreen	4·03	...
Dor.	Evershot, Melbury Ho.	9·37	203	,,	Lilburn Tower Gdns....	3·37	...
,,	Creech Grange	8·52	...	*Cumb.*	Geltsdale.....	5·85	...
,,	Shaftesbury, Abbey Ho.	5·12	131	,,	Carlisle, Scaleby Hall	4·45	133
Devon.	Plymouth, The Hoe ..	5·87	148	,,	Borrowdale, Rosthwaite	16·34	...
,,	Polapit Tamar	6·49	135	,,	Keswick, High Hill ...	9·16	...
,,	Ashburton, Druid Ho.	11·03	182	*Glam.*	Cardiff, Ely P. Stn. ...	7·22	150
,,	Cullompton.....	4·74	115	,,	Treherbert, Tynywaun	18·42	...
,,	Sidmouth, Sidmount...	5·74	154	*Carm.*	Carmarthen Friary ...	8·58	150
,,	Filleigh, Castle Hill ...	7·36	...	,,	Llanwrda, Dolaucothy	10·65	168
,,	Barnstaple, N. Dev. Ath.	7·42	163	*Pemb.*	Haverfordwest, School	9·70	179
Corn.	Redruth, Trewirgie ...	8·30	158	*Card.*	Aberystwyth	6·62	...
,,	Penzance, Morrab Gdn.	6·85	147	,,	Cardigan, County Sch.	7·50	...
,,	St. Austell, Trevarna...	7·28	138	*Brec.*	Crickhowell, Talymaes	8·70	...
Soms.	Chewton Mendip	8·02	166	*Rad.*	Birm W. W. Tyrmynydd	8·79	133
,,	Long Ashton	7·26	...	*Mont.*	Lake Vyrnwy.....	9·34	164
,,	Street, Hind Hayes ...	5·33	...	*Denb.*	Llangynhafal	4·33	...
Glos.	Cirencester, Gwynfa ...	5·01	152	*Mer.*	Dolgelly, Bryntirion...	8·69	143
Here.	Ross, Birchlea.....	5·61	170	*Carn.*	Llandudno	3·76	105
,,	Ledbury, Underdown	5·20	169	,,	Snowdon, L. Llydaw 9	...	...
Salop.	Church Stretton.....	5·16	143	*Ang.*	Holyhead, Salt Island	5·84	146
,,	Shifnal, Hatton Grange	4·40	155	,,	Lligwy.....	5·19	...
Worc.	Ombersley, Holt Lock	4·38	164	*Isle of Man*			
,,	Blockley, Upton Wold	5·01	153		Douglas, Boro' Cem....	...	...
War.	Farnborough	4·34	137	*Guernsey*			
,,	Birminghm, Edgbaston	4·70	169		St. Peter P't. Grange Rd.	9·21	204

Rainfall: October, 1928: Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Stoneykirk, Ardwell Ho	7·79	215	*Suth* .	Loch More, Achfary ...	6·88	88
,, .	Pt. William, Monreith	9·71	...	*Caith* .	Wick	2·53	85
Kirk .	Carsphairn, Shiel.	13·29	...	*Ork* .	Pomona, Deerness	3·78	100
,, .	Dumfries, Cargen	9·25	212	*Shet* .	Lerwick	5·79	146
Dumf .	Eskdalemuir Obs.	11·80	218	*Cork* .	Caheragh Rectory	9·82	...
Roxb .	Branxholm	7·35	226	,, .	Dunmanway Rectory...	9·58	160
Selk .	Ettrick Manse	11·07	...	,, .	Ballinacurra	7·08	174
Peeb .	West Linton	...	...	,, .	Glanmire, Lota Lo. ...	7·68	185
Berk .	Marchmont House.....	3·86	101	*Kerry* .	Valentia Obsy.	8·99	161
Hadd .	North Berwick Res. ...	2·74	93	,, .	Gearahameen	14·20	...
Midl .	Edinburgh, Roy. Obs.	3·00	115	,, .	Killarney Asylum	7·76	145
Ayr .	Kilmarnock, Agric. C.	6·71	191	,, .	Darrynane Abbey	8·68	173
,, .	Girvan, Pinmore	7·94	159	*Wat* .	Waterford, Brook Lo...	7·41	190
Renf .	Glasgow, Queen's Pk. .	5·72	176	*Tip* .	Nenagh, Cas. Lough...	6·74	199
,, .	Greenock, Prospect H.	10·98	204	,, .	Roscrea, Timoney Park	5·12	...
Bute .	Rothesay, Ardencraig .	10·32	234	,, .	Cashel, Ballinamona...	5·60	156
,, .	Dougarie Lodge	8·68	...	*Lim* .	Foynes, Coolnanes.....	6·54	172
Arg .	Ardgour House	12·69	...	,, .	Castleconnel Rec.	5·72	...
,, .	Manse of Glenorchy ...	11·65	...	*Clare* .	Inagh, Mount Callan...	11·11	...
,, .	Oban	8·69	...	,, .	Broadford, Hurdlest'n.	7·36	...
,, .	Poltalloch	7.96	162	*Wexf* .	Newtownbarry	...	...
,, .	Inveraray Castle...	11·96	170	,, .	Gorey, Courtown Ho ..	5·82	165
,, .	Islay, Eallabus	10·55	221	*Kilk* .	Kilkenny Castle.....	5·22	166
,, .	Mull, Benmore	13·50	...	*Wic* .	Rathnew, Clonmannon	6·07	...
,, .	Tiree	6·56	...	*Carl* .	Hacketstown Rectory..	5·65	149
Kinr .	Loch Leven Sluice.....	5·43	158	*QCo* .	Blandsfort House	5·01	143
Perth .	Loch Dhu	13·00	182	,, .	Mountmellick.....	5·41	...
,, .	Balquhidder, Stronvar	11·48	...	*KCo* .	Birr Castle	5·43	186
,. .	Crieff, Strathearn Hyd.	6·17	157	*Dubl* .	Dublin, FitzWm. Sq...	2·60	97
,, .	Blair Castle Gardens ...	5·82	188	,, .	Balbriggan, Ardgillan.	3·72	138
,, .	Dalnaspidal Lodge ...	11·45	201	*Me'th* .	Beauparc, St. Cloud...	3·90	...
Forf .	Kettins School	4·62	162	,, .	Kells, Headfort	5·47	163
,, .	Dundee, E. Necropolis	3·80	143	*W.M* .	Moate, Coolatore	5·11	...
,, .	Pearsie House.....	4·71	...	,, .	Mullingar, Belvedere..	4·94	158
,, .	Montrose, Sunnyside...	3·48	126	*Long* .	Castle Forbes Gdns.....	5·10	157
Aber .	Braemar, Bank	4·33	129	*Gal* .	Ballynahinch Castle ...	11·25	188
,, .	Logie Coldstone Sch....	2·72	84	,, .	Galway, Grammar Sch.	6·57	...
,, .	Aberdeen, King's Coll.	2·83	94	*Mayo* .	Mallarauny.....	9·70	...
,, .	Fyvie Castle	2·39	...	,, .	Westport House.....	7·91	176
Mor .	Gordon Castle	1·89	60	,, .	Delphi Lodge	14·98	...
,, .	Grantown-on-Spey ...	2·11	71	*Sligo* .	Markree Obsy.....	7·36	179
Na .	Nairn, Delnies	2·31	98	*Cav'n* .	Belturbet, Cloverhill...	4·14	142
Inv .	Kingussie, The Birches	4·47	...	*Ferm* .	Enniskillen, Portora...	5·27	...
,, .	Loch Quoich, Loan ...	17·00	...	*Arm* .	Armagh Obsy.....	4·70	173
,, .	Glenquoich.....	15·56	156	*Down* .	Fofanny Reservoir.....	17·50	...
,, .	Inverness, Culduthel R.	2·74	...	,, .	Seaforde	5·88	165
,, .	Arisaig, Faire-na-Squir	7·30	...	,, .	Donaghadee, C. Stn ...	5·59	193
,, .	Fort William	10·53	...	,, .	Banbridge, Milltown...	4·41	160
,, .	Skye, Dunvegan	9·68	...	*Antr* .	Belfast, Cavehill Rd ...	6·41	...
R & C.	Alness, Ardross Cas. ...	4·39	114	,, .	Glenarm Castle	7·77	...
,, .	Ullapool	3·91	...	,, .	Ballymena, Harryville	5·89	157
,, .	Torridon, Bendamph...	9·09	113	*Lon* .	Londonderry, Creggan	5·99	163
,, .	Achnashellach	10·07	...	*Tyr* .	Donaghmore	6·51	...
,, .	Stornoway	5·07	98	,, .	Omagh, Edenfel.....	5·29	144
Suth .	Lairg	4·41	...	*Don* .	Malin Head.....	6·26	212
,, .	Tongue	3·43	82	,, .	Dunfanaghy	5·78	...
,, .	Melvich	4·29	117	,, .	Killybegs, Rockmount.	9·21	164

Climatological Table for the British Empire, May, 1928.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal.	Days	Hours per day	Percentage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	in.	in.			
London, Kew Obsy.	1013·6	— 2·3	76	35	60·8	45·1	52·9	— 0·5	46·2	79	6·8	1·76	+ 0·04	9	5·3	34
Gibraltar	1014·5	— 1·6	79	52	69·0	56·1	62·5	— 3·0	55·1	81	4·6	1·93	+ 0·20	13	..	..
Malta	1013·0	— 2·0	77	54	69·5	59·2	64·3	— 1·6	59·1	77	4·5	0·00	— 0·41	0	10·1	72
St. Helena	1013·7	+ 2·5	69	56	66·8	58·5	62·7	— 0·9	59·5	93	7·5	1·61	— 2·54	14	..	..
Sierra Leone	1012·0	+ 0·8	91	69	87·4	73·7	80·5	— 1·0	76·5	80	8·6	7·60	— 3·87	23	..	..
Lagos, Nigeria	1009·8	— 1·2	89	71	86·6	75·8	81·2	— 0·6	76·9	83	7·6	15·33	+ 4·86	19	..	..
Kaduna, Nigeria	1014·4	+ 1·3	95	..	88·7	..	..	..	73·4	78	1·4	6·78	+ 0·84	13	..	..
Zomba, Nyasaland	1017·6	+ 2·5	78	49	71·7	56·2	63·9	— 1·9	..	79	6·0	0·81	— 0·23	5	..	..
Salisbury, Rhodesia	1017·5	+ 1·0	78	39	73·1	45·1	59·1	— 1·5	51·8	53	2·1	0·00	— 0·54	0	9·2	81
Cape Town	1021·1	+ 3·1	90	45	71·7	52·1	61·9	+ 3·0	52·5	87	4·8	0·36	— 3·47	5	..	..
Johannesburg	1023·2	+ 2·7	75	40	65·5	45·5	55·5	+ 1·1	44·5	48	1·5	0·20	— 0·56	1	9·3	86
Mauritius	1016·0	— 0·4	84	60	78·6	68·2	73·4	+ 0·8	71·2	79	5·3	14.91	+ 11·88	18	6·9	62
Bloemfontein	..	..	75	28	69·6	38·7	54·1	+ 1·4	42·7	57	0·9	0·04	— 1·14	1	..	..
Calcutta, Alipore Obsy.	1003·9	+ 0·4	100	70	94·5	78·5	86·5	+ 0·5	80·1	83	6·6	7·06	+ 1·31	13*	..	..
Bombay	1007·5	+ 0·1	94	78	92·2	80·5	86·3	+ 0·4	77·6	71	3·3	0·00	— 0·55	0*	..	..
Madras	1004·8	— 0·6	110	77	101·1	83·3	92·2	+ 2·3	78·1	58	2·5	0·03	— 1·04	1*	..	..
Colombo, Ceylon	1009 3	+ 0·7	89	75	87·8	77·8	82·8	+ 0·3	79·1	79	8·0	7·92	— 4·76	26	7·8	63
Hongkong	1008·3	— 1·1	89	69	81·8	74·0	77·9	+ 0·5	74·5	85	8·0	18·41	+ 6·81	18	4·3	33
Sandakan	..	..	91	74	89·0	76·5	82·7	+ 0·1	79·0	83	..	7·34	+ 1·43	11	..	..
Sydney	1021·3	+ 2·7	74	46	66·1	50·3	58·2	— 0·6	51·6	77	4·1	2·74	— 2·39	14	6·4	61
Melbourne	1022·4	+ 2·9	71	35	61·1	47·3	54·2	+ 0·1	49·4	77	6·8	2·24	+ 0·06	16	4·5	45
Adelaide	1022·7	+ 2·6	79	39	65·9	49·0	57·5	— 0·4	50·3	62	5·2	1·74	— 1·02	12	6·3	62
Perth, W. Australia	1018·7	+ 0.2	89	41	71·1	51·9	61·5	+ 0·9	54·7	66	5·4	5·08	+ 0·14	11	5·9	57
Coolgardie	1020·2	+ 0·4	84	33	70·3	45·7	58·0	+ 0·4	51·3	59	2·8	0·52	— 0·84	4	..	..
Brisbane	1020·6	+ 1·8	77	47	71·7	53·5	62·6	— 1·9	56·5	69	3·3	1·82	— 1·01	13	7·6	70
Hobart, Tasmania	1018·4	+ 2·8	68	35	57·2	44·8	51·0	+ 0·6	45·7	71	6·1	1·41	— 0·45	17	4·4	45
Wellington, N.Z.	1012·5	— 3·1	65	40	59·6	49·0	54·3	+ 1·6	51·3	79	6·0	4·38	— 0·30	17	5·0	51
Suva, Fiji	1012·0	— 0·8	87	68	83·1	71·9	77·5	+ 1·0	75·0	86	5·6	13·64	+ 3·48	21	6·1	54
Apia, Samoa	1011·3	+ 0·2	87	71	85·4	73·9	79·7	+ 1·3	76·9	78	4·2	6·51	+ 1·00	15	7·9	69
Kingston, Jamaica	1012·8	— 0·3	89	64	87·1	72·9	80·0	+ 0·3	71·8	80	3·7	1·77	— 2·62	6	..	..
Grenada, W.I.	1010·6	— 1·9	89	70	87·3	73·8	80·5	+ 0·9	75·0	69	4·7	0·63	— 3·96	13	..	..
Toronto	1013·6	— 1·2	82	33	64·1	44·2	54·1	+ 1·4	46·3	57	4·4	0·72	— 2·26	9	7·3	50
Winnipeg	1015·3	+ 1·0	96	26	69·4	42·4	55·9	+ 4·3	..	..	3·4	3·33	+ 1·03	5	10·0	65
St. John, N.B.	1013·9	— 0·1	71	34	57·4	42·2	49·8	+ 2·1	45·3	69	6·5	2·17	— 1·54	14	6·1	41
Victoria, B.C.	1017·9	+ 1·5	78	41	63·6	47·3	55·5	+ 2·4	51·2	70	3·8	0·32	— 0·98	3	10·5	69